

**REMARKS**

Claims 2-42 are pending in the Application. Claims 2 and 9 have been amended, claims 7, 8, 10 and 15 have been canceled and claims 20-41 have been withdrawn from consideration. Claims 43-49 have been added.

The Applicant notes that the present application claims priority to US Provisional Application Serial No. 60/167,498 filed November 24, 1999. The specification has been amended to indicate the claim of priority.

The Examiner has objected to the disclosure because of informalities. These informalities have been corrected in a previous amendment to the specification, which was filed on September 16, 2002. In the previous amendment, the word "tuning" was inserted before the word "capacitors" on page 3, line 7 of the specification. Accordingly, the Applicant believes this issue has been addressed and resolved. The amendment has been repeated herein in the event it erroneously was not entered.

The Examiner has objected to Figures 1a, 2a, 3a and 4a, indicating that these figures should be designated as prior art. The Applicant submits that a Formal Request for Approval of Drawing Changes was filed on September 16, 2002. In the formal request, Figures 1a, 2a, 3a and 4a were designated with a "Prior Art" legend. Accordingly, the Applicant believes this issue has been addressed and resolved. A copy of the Formal Request for Approval of Drawing Changes filed on September 16, 2003 is included herewith.

The Examiner has objected to Figure 9, indicating that it should be designated as prior art. On August 8, 2003, the Applicant filed a Formal Request of Approval of Drawing Changes for Figure 9. In the formal request, the coil of original Figure 9 was replaced with a coil array in accordance with the present application. Accordingly, Figure 9 does not show a prior art configuration and thus the "Prior Art" designation is not believed to be required. The Applicant believes this matter has been addressed and resolved. A copy of the Formal Request for Approval of Drawing Changes filed on August 8, 2003 is included herewith.

The Examiner has required a formal set of drawings for publication. A formal set of drawings are included with this Reply to the Office Action.

***I. ELECTION/RESTRICTION***

The Examiner has issued a restriction requirement. The Examiner considers claims 3-19 and 42 to be a separate species (species I) from claims 20-41 (species II). Claim 2 has been identified as being generic to both species I and II.

Applicant hereby confirms election of species I, claims 2-19 and 42, without traverse.

***II. REJECTION OF CLAIM 2-19 AND 42 UNDER 35 USC §102(b)***

Claims 2-19 and 42 stand rejected under 35 USC §102(b) based on US Patent No. 5,777,474 issued to *Srinivasan* (hereinafter the '474 patent). Withdrawal of the rejection is respectfully requested for at least the following reasons.

***a. Claim 2***

Amended claim 2 recites an integrated radio-frequency coil array that includes three coils; a first coil, a second coil, and a third coil. The second coil and the third coil share a common coil path that includes at least one reactive component.

The '474 patent discloses a coil for radio-frequency analysis that includes an RF coil primary and an RF coil secondary (see Fig. 6 of the '474 patent - reproduced below). The Examiner has interpreted a third coil in Fig. 6 to be a combination of the impedance connections between the primary coil and the secondary coil. The Applicant respectfully disagrees with the Examiner's interpretation of Fig. 6 of the '474 patent.

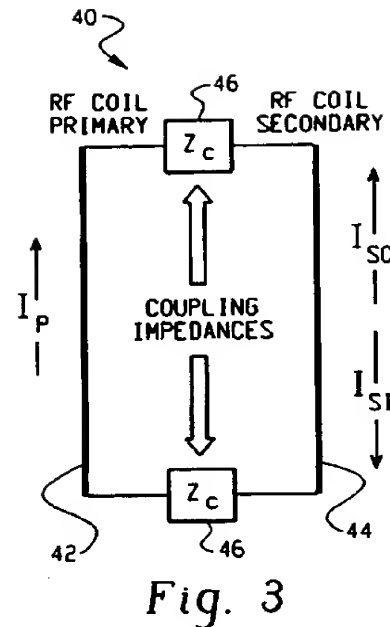
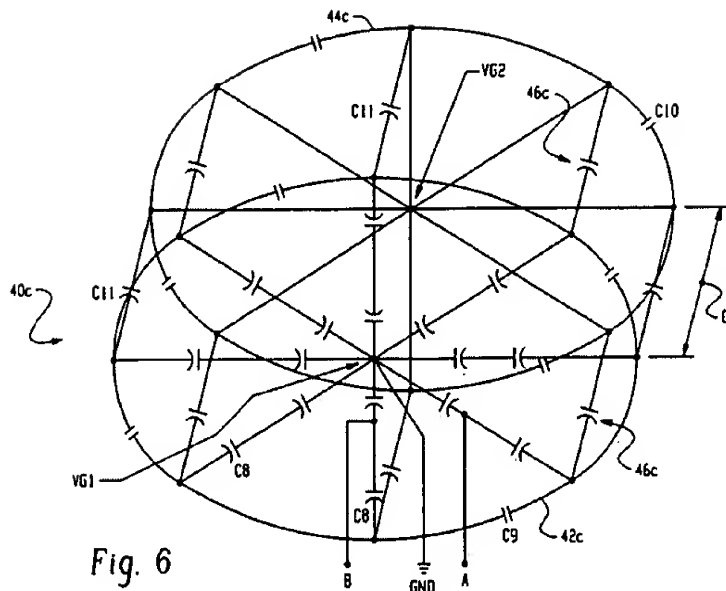


Figure 6 of the '474 patent (reproduced above) illustrates a quadrature surface coil. A simplified schematic of the coil is illustrated in Fig. 3 of the '474 patent (reproduced above), which clearly shows a primary coil 42 and a secondary coil 44. Additionally, Fig. 3 illustrates coupling impedances 46 between the primary coil 42 and the secondary coil 44. Clearly, the third coil identified by the Examiner is not considered a coil as disclosed in the '474 patent, but as a coupling impedance. Nowhere has it been shown that the '474 patent teaches or suggests a coil array that includes three coils, as recited in amended claim 2 of the present application.

Claim 2 further recites a first driving means for driving the first coil to image, a second driving means for driving the second coil to image, and a third driving means for driving the third coil to image. The three driving means permit at least two coils of the coil array to image simultaneously to obtain a combined image. Additionally, the three driving means permit each coil to image independently.<sup>1</sup> The '474 patent does not teach or suggest that at least two coils can be driven to image simultaneously to

<sup>1</sup> See page 12, lines 8-12 of the specification

obtain a combined image and each coil can be driven to image independently, as recited in amended claim 2.

Accordingly, withdrawal of the rejection of claim 2 is respectfully requested.

***b. Claims 3-19 and 42***

Claims 3-19 and 42 directly or indirectly depend from amended claim 2 and thus can be distinguished from the '474 patent for at least the same reasons.

Accordingly, withdrawal of the rejection of claims 3-19 and 42 is respectfully requested.

***c. New claims 43-48***

New claim 43 depends from claim 2 and further recites that the second coil and the third coil are situated such that the first common coil path falls over a central virtual ground plane of the first coil. Support for new claim 43 can be found, for example, on page 13, lines 7-10 of the specification.

New claim 44 depends from claim 2 and further recites that each coil is driven simultaneously to obtain an independent image. New claim 45 depends from claim 2 and further recites that each coil is driven individually to obtain an independent image. Support for new claims 44 and 45 can be found, for example, on page 12, lines 8-12 of the specification.

New claim 46 depends from claim 2 and further recites that each driving means includes an inductive coupling loop, and the second coupling loop and the third coupling loop are overlapped to cancel a net mutual flux between the second and third inductive coupling loops. New claim 47 depends from claim 2 and further recites that first driving means is selected from the group consisting of inductive coupling and capacitive coupling. New claim 48 depends from claim 47 and further recites that the second and third coil are driven across the reactive component. New claim 49 depends from claim 2 and recites the first driving means is a rectangular loop and the second and third driving means are combined into a figure eight loop. Support for new claims 46-49 can be found, for example, in Figs. 6a and 7b, and page 14, lines 8-19.

**III. Cited Prior Art of Record**

The prior art of record, while cited by the Examiner, was not applied to original claim 2. Thus, no arguments were presented by the Examiner why the cited prior art is relevant. In anticipation of the cited prior art of record being applied to the amended claims, the Applicant provides the following reasons why the amended claims are distinguishable from the cited prior art.

**a. US Patent No. 5,602,479 issued to Srinivasan (hereinafter the '479 patent)**

The '479 patent discloses a quadrature radio-frequency coil for imaging a patient's head. The coil includes a first ring and a second ring. The two rings are coupled to each other via a plurality of impedances.<sup>2</sup> Nowhere, however, does the '479 patent disclose a third coil. The '479 patent does not teach or suggest a first coil, a second coil and a third coil, as recited in amended claim 2 of the present application.

Accordingly, the '479 patent cannot anticipate the subject matter of amended claim 2.

**b. US Patent No. 5,194,811 issued to Murphy-Boesch et al. (hereinafter the '811 patent)**

The '811 patent discloses a radio-frequency volume resonator that includes two pairs of adjacent ring paths. The resonator includes four conductive rings, two inner rings and two outer rings. Inductive loop coupling or capacitive coupling can be used to couple power to and receive signals from the resonator. The dual RF resonator can be operated simultaneously and in circularly polarized mode.<sup>3</sup> Simultaneous operation of the dual RF resonator implies multiple resonators (i.e., more than one) being operated at the same time. The meaning of circularly polarized mode, however, requires a review of the '811 specification.

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<sup>2</sup> See Fig. 6 and column 6, lines 16-27 of the '479 patent

<sup>3</sup> See column 9, lines 7-9 of the '811 patent

According to the '811 specification, a simple embodiment of a circularly polarized coil is two circular loop coils positioned 90 degrees with respect to one another. When transmitter power is applied to the ports of each single-tuned coil 90 degrees out of phase, a single circular polarization will be generated at the center of the two coils.<sup>4</sup> Thus, circularly polarized mode involves operation of multiple coils at the same time.

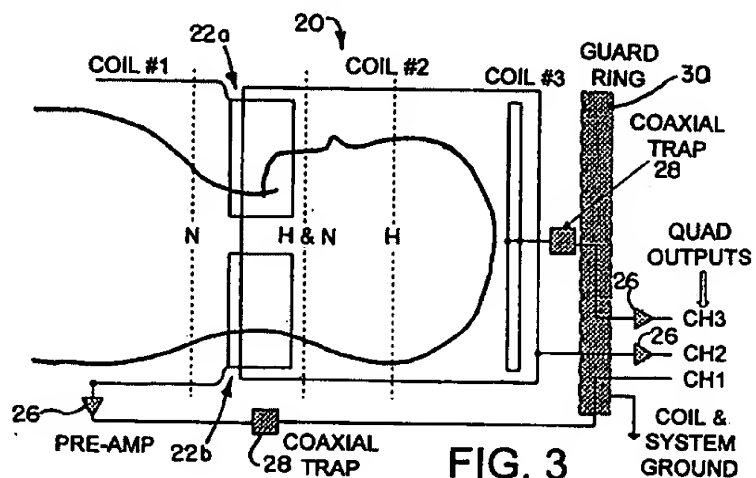
Accordingly, the two modes of operation disclosed in the '811 patent, simultaneous operation and circularly polarized mode, require operation of multiple coils. The '811 patent does not teach or suggest an integrated RF coil array that includes three coils, a driving means for each coil, wherein at least two coils can be driven simultaneously to obtain a combined image and each coil can be driven independently to obtain an image, as recited in amended claim 2 of the present application.

Accordingly, the '811 patent cannot anticipate the subject matter of amended claim 2.

**c. US Patent No. 6,177,797 issued to Srinivasan (hereinafter the '797 patent)**

The '797 patent discloses a radio-frequency (RF) coil that includes three coils. The RF coil includes a first coil utilizing two counter-rotating helmholtz pairs, a second birdcage coil, and a third spoke type quadrature surface coil.<sup>5</sup>

Referring to Fig. 3 of the '797 patent (reproduced at right), coil #1 (the helmholtz pairs) overlaps coil #2, but coil #1 is not electrically coupled to



<sup>4</sup> See column 7, lines 32-51 of the '811 patent

<sup>5</sup> See column 5, lines 20-27 of the '797 patent

coil #2. Thus, a common coil path does not exist between coil #1 and coil #2. Additionally, coil #1 does not overlap coil #3 and coil #1 is not electrically coupled to the coil #3. Accordingly, coil #1 does not have a common coil path with coil #3. Similarly, coil #2 overlaps coil #3 (coil #2 surrounds coil #3 in Fig. 3), but coil #2 is not electrically coupled to coil #3. Thus, coil #2 and coil #3 do not have a common coil path. The '797 patent does not teach or suggest a first common coil path that includes at least one reactive component, wherein the second coil and the third coil share the first common coil path, as recited in amended claim 2 of the present application.

Furthermore, the '797 patent does not teach or suggest that a combined field of view (FOV) of the second and third coil is substantially equivalent to an FOV of the first coil, as recited in amended claim 2 of the present application.

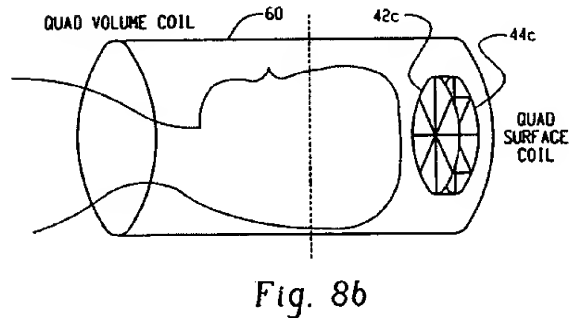
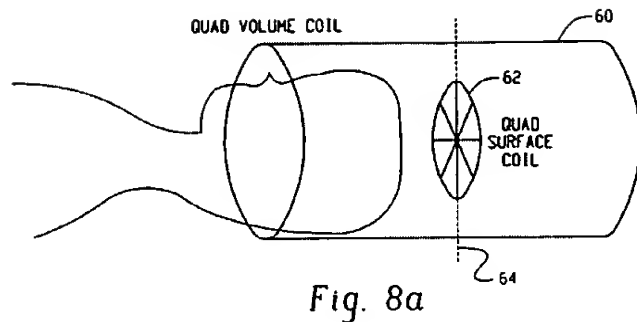
Accordingly, the '797 patent cannot anticipate the subject matter of amended claim 2.

**d. US Patent No. 5,999,000 issued to Srinivasan (hereinafter the '000 patent)**

The '797 patent discloses a radio-frequency coil that is a variation of the '474 patent. More specifically, the '000 patent discloses a quadrature surface coil within a quadrature volume coil (see, e.g., Figs. 8a and 8b of the '000 patent, reproduce below).

As was discussed above with respect to the rejection of claim 2 based on the '474 patent, the quadrature surface coil does not anticipate the present invention. Therefore, only the combination of the quadrature surface coil and the quadrature volume coil will be discussed here.

As can be seen in Figs. 8a and 8b, the quadrature surface coil 62 is encompassed by the quadrature volume coil 60. A field of view (FOV) of the quadrature volume coil 60 exists within the volume of the quadrature volume coil and along a central axis (e.g., a centerline passing through the volume coil and the surface coil). Similarly, an FOV of the quadrature surface coil exists within the diameter of the primary coil 42c and the diameter of the secondary coil 44c. Since the primary coil and the secondary coil are substantially the same diameter and aligned on the same axis, there is no additive effect when the FOV of the primary coil is combined with the FOV of the secondary coil.



Since the volume coil encompasses the surface coil, the diameter of the volume coil must be larger than the diameter of the surface coil. Therefore, the FOV of the volume coil 60 is larger than the FOV of the surface coil 62. The '000 patent does not teach or suggest a first coil having a first FOV, a second coil having a second FOV, and a third coil having a third FOV, wherein a combined FOV of the second and third coil is substantially equivalent to the FOV of the first coil, as recited in amended claim 2 of the present application.

Accordingly, the '000 patent cannot anticipate the subject matter of amended claim 2.



**e. US Patent No. 6,285,189 issued to Wong (hereinafter the '189 patent)**

The '189 patent discloses a birdcage coil that includes a number of elements, wherein the density of the elements is such that the contribution to the total inductance from the mutual inductance of the elements exceeds 45% by conventional model calculation.<sup>6</sup> More specifically, the birdcage coil disclosed in the '189 patent is a millipede coil, wherein the number of legs that comprise the coil are significantly higher than the number of legs of a conventional birdcage coil.

Thus, the '189 patent discloses a modification of the conventional birdcage coil, wherein the number of elements (e.g., legs) is significantly increased. The '189 patent, however, does not teach or suggest an integrated coil array that includes a first coil, a second coil and a third coil, a driving means for each respective coil, wherein at least two coils can be driven simultaneously to obtain a combined image and each coil can be driven independently to obtain an image. Additionally, the '189 patent does not teach or suggest a common coil path that includes at least one reactive component, wherein the second coil and the third coil share the first common coil path, as recited in amended claim 2 of the present application.

Accordingly, the '189 patent cannot anticipate the subject matter of amended claim 2.

**f. US Patent No. 4,694,255 issued to Hayes (hereinafter the '255 patent)**

The '255 patent discloses a birdcage coil for nuclear magnetic resonance (NMR). Fig. 10 of the '255 patent (reproduced at right) illustrates one embodiment of the invention, wherein a plurality of parallel conductors 120, electrically shorted at one of the ends 121, are plated on the outside surface of a dielectric cylindrical form 122. A similar cylindrical form 124 having a slightly smaller diameter than that of form 122 also has a plated thereon a

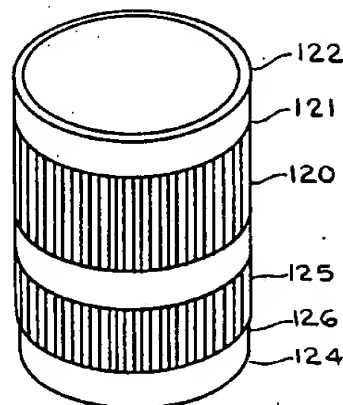


FIG. 10

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<sup>6</sup> See Abstract of the '189 patent

plurality of parallel conductors 125 shorted at there ends 126. Cylindrical form 124 having a smaller diameter than that of form 122 is adapted to be slidably inserted thereinto, such that the unshorted ends 120, 125 of the conductors overlap.<sup>7</sup> Tuning of the coil is accomplished by varying the degree of overlap or relative length of the conductive coil elements.<sup>8</sup>

Thus, by virtue of the different diameters of the coil ends, the coils have a different field of view. Thus, the '255 patent does not teach or suggest a first coil having a first FOV, a second coil having a second FOV and a third coil having a third FOV, wherein a combined FOV of the second and third coil is substantially equivalent tot he FOV of the first coil. Additionally, the '255 patent does not teach or suggest a common coil path that includes at least one reactive component, wherein the second coil and the third coil share the common coil path. Moreover, the '255 patent does not teach or suggest a coil array, wherein at least two coils can be driven simultaneously to obtain a combined image and each coil can be driven independently to obtain an image, as recited in amended claim 2 of the present application.

Accordingly, the '255 patent cannot anticipate the subject matter of amended claim 2.

#### **IV. CONCLUSION**

Accordingly, claims 2-19 and 42-45 are believed to be allowable, and the application is believed to be in condition for allowance. A prompt action to such end is earnestly solicited.

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<sup>7</sup> See column 13, lines 16-34 of the '255 patent

<sup>8</sup> See column 13, lines 53-59 of the '255 patent

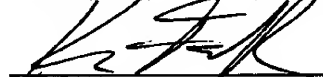
Serial No.: 09/721,249

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should a petition for an extension of time be necessary for the timely reply to the outstanding Office Action (or if such a petition has been made and an additional extension is necessary), petition is hereby made and the Commissioner is authorized to charge any fees (including additional claim fees) to Deposit Account No. 18-0988.

Respectfully submitted,

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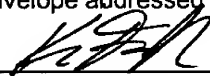
DATE: MARCH 16, 2004

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